



US009636659B2

(12) **United States Patent**
Cheung et al.

(10) **Patent No.:** **US 9,636,659 B2**
(45) **Date of Patent:** ***May 2, 2017**

(54) **SELECTIVE HYDROGENATION CATALYST AND METHODS OF MAKING AND USING SAME**

(71) Applicant: **Chevron Phillips Chemical Company LP**, The Woodlands, TX (US)

(72) Inventors: **Tin-Tack Peter Cheung**, Kingwood, TX (US); **Joseph Bergmeister, III**, Kingwood, TX (US); **Stephen L. Kelly**, Kingwood, TX (US)

(73) Assignee: **Chevron Phillips Chemical Company LP**, The Woodlands, TX (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **14/799,440**

(22) Filed: **Jul. 14, 2015**

(65) **Prior Publication Data**

US 2015/0314270 A1 Nov. 5, 2015

Related U.S. Application Data

(63) Continuation of application No. 14/224,887, filed on Mar. 25, 2014, now Pat. No. 9,144,787, which is a continuation of application No. 13/414,544, filed on Mar. 7, 2012, now Pat. No. 9,108,188.

(51) **Int. Cl.**

B01J 23/00 (2006.01)

B01J 23/50 (2006.01)

B01J 35/10 (2006.01)

B01J 37/08 (2006.01)

B01J 37/18 (2006.01)

B01J 37/24 (2006.01)

B01J 21/04 (2006.01)

B01J 23/44 (2006.01)

B01J 37/00 (2006.01)

C07C 7/167 (2006.01)

C07C 5/08 (2006.01)

C07C 5/09 (2006.01)

(52) **U.S. Cl.**

CPC **B01J 23/50** (2013.01); **B01J 21/04** (2013.01); **B01J 23/005** (2013.01); **B01J 23/44** (2013.01); **B01J 35/109** (2013.01); **B01J 35/1009** (2013.01); **B01J 35/1014** (2013.01); **B01J 35/1038** (2013.01); **B01J 35/1042** (2013.01); **B01J 35/1061** (2013.01); **B01J 35/1066** (2013.01); **B01J 35/1071** (2013.01); **B01J 35/1076** (2013.01); **B01J 37/0009** (2013.01); **B01J 37/08** (2013.01); **B01J 37/18** (2013.01); **B01J 37/24** (2013.01); **C07C 5/08** (2013.01); **C07C 5/09** (2013.01); **C07C 7/167** (2013.01); **Y02P 20/52** (2015.11)

(58) **Field of Classification Search**

None

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,679,762 A	7/1972	La Hue et al.
3,770,617 A	11/1973	Riley et al.
3,898,155 A	8/1975	Wilson
3,898,322 A	8/1975	Leach
4,115,248 A	9/1978	Mulaskey
4,257,877 A	3/1981	Mahendroo
4,301,037 A	11/1981	Sanchez et al.
4,404,124 A	9/1983	Johnson et al.
4,410,715 A	10/1983	McMullen et al.
4,484,015 A	11/1984	Johnson et al.
4,499,203 A	2/1985	Toulhoat et al.
4,762,956 A	8/1988	Liu et al.
5,057,481 A	10/1991	Bhasin
5,514,362 A	5/1996	Miller
5,558,851 A	9/1996	Miller
5,935,897 A	8/1999	Trübenbach et al.
6,417,136 B2	7/2002	Cheung et al.
6,573,214 B2	6/2003	Abdo et al.
6,600,056 B1	7/2003	Mikawa et al.

(Continued)

FOREIGN PATENT DOCUMENTS

CA	2576964 C	3/2012
CN	1361231 A	7/2002

(Continued)

OTHER PUBLICATIONS

English translation of Chinese Patent Publication No. 101433842A, published on May 20, 2009, 16 pages.

Foreign communication from a related counterpart application—International Preliminary Report on Patentability, PCT/US2013/058514, Mar. 8, 2016, 15 pages.

Alerasool, Saeed, "Emerging Trends in Industrial Catalysis," Catalysis Club of Chicago, Apr. 4, 2005, pp. 1-69, Engelhard Corporation.

Che, Chunxia, et al., "C2 front-end hydrogenation catalyst and preparation method," machine translation of Chinese Patent Publication No. 102989453, published on Mar. 27, 2013, 17 pages.

Database WPI/Thomson Scientific, Week 201360, XP-002721624, abstract of CN102989453, 2 pages.

English Translation of Chinese Patent Publication No. 1361231A, 11 pages.

English Translation of Chinese Patent Publication No. 1364855A, 26 pages.

English Translation of Chinese Patent Publication No. 102989453A, 28 pages.

(Continued)

Primary Examiner — Colin W Slifka

(74) *Attorney, Agent, or Firm* — Conley Rose, P.C.;

Rodney B. Carroll; Lynda S. Jolly

(57) **ABSTRACT**

A composition comprising an extruded inorganic support comprising an oxide of a metal or metalloid, and at least one catalytically active metal, wherein the extruded inorganic support has pores, a total pore volume, and a pore size distribution, wherein the pore size distribution displays at least two peaks of pore diameters, each peak having a maximum, wherein a first peak has a first maximum of pore diameters of equal to or greater than about 120 nm and a second peak has a second maximum of pore diameters of less than about 120 nm, and wherein greater than or equal to about 5% of a total pore volume of the extruded inorganic support is contained within the first peak of pore diameters.

23 Claims, 5 Drawing Sheets